

ECOLOGICAL AND HUMAN BENEFITS OF SEZ RESTORATION

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April 3rd, 2010

INTRODUCTION

As Homewood Mountain Resort undergoes a facilities redevelopment, ecological and habitat elements of the Homewood watersheds are also being improved. The main areas that will be directly affected by the redevelopment will be the North and South Base areas. The upper mountain, long impacted by old logging roads and other legacy impacts, is being treated through a systematic watershed restoration program where over 240,000 ft² of roads have already been removed and/or treated, with at least another 260,000ft² of roads slated for treatment in the future. While the upper mountain restoration is targeting legacy impacts, the base areas will target reduction of sediment and nutrients through construction-related improvements such as low impact development-types of treatments and infiltration facilities.

The redevelopment project will retain much of the North and South base areas as impervious coverage. However, within the redevelopment plan, HMR is proposing to undertake two SEZ restoration projects: a wetland restoration project near the North Base and a stream restoration project at the South Base. This document describes the South Base stream restoration project.

The South Base Homewood (Ellis) Creek restoration project consists of widening approximately 340 feet of constrained stream channel, construct a set of step pools through the area and create primary and secondary flood plains to the extent possible. The intent of this project includes ecological and aesthetic improvement of the restored area while addressing several 'beneficial uses' which are those water related elements as defined by the Lahontan Water Quality Control Board Basin Plan. This report describes a generalized restoration approach and the benefits from implementing this stream restoration. Specific construction plans will be developed as the project gets closer to actual construction and as engineering plans are finalized.

CURRENT CONDITIONS

Homewood (Ellis) Creek has headwaters high up in the steep, rocky watershed which makes up part of the Homewood Mountain Resort. The creek is fed by at least two springs. The lower spring is less than ½ mile upstream from the restoration area and in most years runs year round. Thus Homewood Creek in the South Base area typically also runs year round even though sections of the stream at mid mountain may be dry or stagnant. In fact, water quality data indicates that water quality in the base area is in some years better than that which exists high up in the undisturbed portions of the watershed. However, as in many recreation and residential areas, creeks at Homewood have been constrained and channelized in order to allow for additional ground surface on which to build or use for other purposes. Historically, creeks themselves took on a lower level of importance. Now, we are gaining a greater realization of the importance of creeks from both an environmental and aesthetic standpoint. It is with this in mind, and with the intention of reversing years of neglect that we propose to restore a section of Homewood Creek in the vicinity of the HMR South Base redevelopment.

Current conditions consist of a highly constrained creek section with steep, artificially constructed banks and a culverted section under Tahoe Ski Bowl Way and an area that is bordered on both sides by paved parking areas.

The maximum flow corridor width above an existing foot bridge and above the culverted section is approximately 20-25 feet. Using a median value, the total potential cross sectional area is 247.5 ft². Following construction, the maximum bank full height will remain at 10-12 feet but the maximum flow corridor width will extend to a minimum of 40 feet at the road crossing and up to 60 feet above that

crossing. Using the ultra-conservative value of 40 feet, the post restoration minimum cross sectional area would be 460 ft². Additionally, the new configuration will also contain primary and secondary flood plains which will allow for additional benefits from those areas including increased habitat and maximum wetted cross sectional area.

The creek is currently constrained physically, ecologically and aesthetically.



Figure 1: Photo of Homewood Creek showing constrained flow path and steep sided banks

LIABILITY ASSESSMENT

Current conditions lead to the following liabilities (note: liabilities in the sense used here refer to levels of ecosystem services that are below optimal):

- Increased velocity and energy in the constrained sections (relative to the optimal potential)
- Lower contact time with bed and banks, thus reducing groundwater recharge potential
- Increased bed and bank erosion due to increased velocities
- No soil contact time in the culverted area
- Potential for sediment and oil-grease laden snow to reach creek from the parking lot areas
- Probability of culvert clogging by branches and other debris, thus causing potential massive erosion and property damage from flooding
- Lack of flood plain contact due to lack of primary flood plain
- Increased probability of flooding due to lack of volumetric capacity in constrained channel

- Limited aesthetic appeal due to lack of access and low level of surrounding aesthetic appeal

FLOW RATES

IERS has implemented near continuous flow monitoring in Homewood Creek at the South Base since the summer of 2009. Volumetric flow rates during spring snowmelt range from a maximum peak of 26 cfs to a normal peak of 10-20 cfs to a summer steady state average of 0.13 cfs. The 26 cfs value was, no doubt, exceeded during the December 2005 and the January 1997 peak flows. However, no measurements were taken during those flow events.

FUTURE CONDITION BENEFITS

Existing conditions of the stream in the South Base area have been driven by human needs and values. In a similar manner, future conditions are driven by different human values. Those values are more closely aligned with our current understanding of habitat and other ecological functions. Input variables also include a more current understanding of the liabilities of a tightly constrained creek, as is the case with Homewood Creek. Liabilities include increased potential for flooding, bank collapse and channel clogging, all of which can result in property damage to the land owner and downstream neighbors. Further, future conditions take into account those beneficial uses that are listed in the Lahontan Basin Plan, many if not most of which coincide with other project driven benefits.

BENEFITS

When a stream cross section is widened, the resulting additional area allows water to slow in that area, thus reducing kinetic energy. This condition changes a number of physical and biological components of the stream. In a highly constrained creek, such as Homewood Creek in the restoration area, these changes tend to be beneficial. The following list describes the most obvious benefits of the Homewood Creek restoration.

- Flood attenuation
 - By widening the stream cross section, we allow more space for water to be contained in. This basic principle of stream restoration is shown in Figures 6 and 7, which describe graphically how widening the stream channel and incorporating multiple flood plains allows water to stay within the banks. Figure 6 shows how flood flows are likely to exceed bank full capacity and flood the surrounding areas, thus creating ecological and human liabilities.
- Culvert removal=less opportunity for clogging, damming and releasing
 - Homewood Creek within the restoration area is currently constrained by a culvert. Culverts present a significant potential for clogging by debris in large flow events, which often leads to culvert failure and the subsequent release of great amounts of sediment into the waterway. The restoration plan includes a 'bottomless culvert', or bridge across the creek which will allow bed contact and greatly reduce the potential for clogging. For a graphic description of culvert failure, go to:
http://www.youtube.com/watch?v=p_uqPR4lr5o
- Bed contact
 - Removal of the culvert allows for additional streambed contact. Currently, the culvert run of the stream eliminates any bed contact and associated groundwater recharge potential and aquatic invertebrate habitat.
- Ground water recharge
 - In addition to the culvert elimination of groundwater recharge in that area, widening of the creek and reduction of flow rates in the restoration area through widening and low

flow meanders results in additional contact time for water moving through that section, thus allowing more time for groundwater recharge. Additionally, a wider stream profile, which results in more potential cross sectional wetted area, allows for more lateral rewatering of the soil profile in the restoration area.

- Bank erosion reduction
 - By widening the wetted cross sectional profile, flow rates are reduced, thus lowering the energy available for bank cutting and erosion.
- Fish passage
 - Fish passage potential will be enhanced by creating a more advantageous environment for small fish. The restoration plan includes small step pools and removal of the culvert which allows for more fish-friendly habitat.
- Aeration
 - Aeration is the process of introducing oxygen into the water column. Natural streams, especially in high gradient environments such as exist in the Homewood Creek watershed, tend to be well aerated due to the multiple steps that occur in the stream channel. When water is forced over rocks or other obstacles, oxygen is introduced as water goes from laminar to turbulent flow, as shown in figure 2.

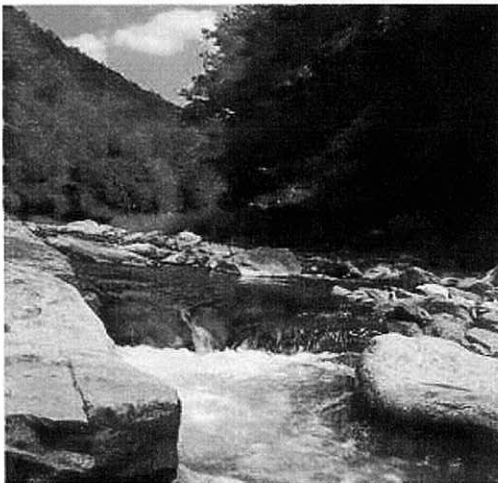


Figure 2: laminar to turbulent flow in a creek, showing oxygenation

Aeration has multiple benefits that align with the Lahontan Basin Plan beneficial uses. Some of the well known benefits of aeration include:

- Reintroduction of O_2 into the water column, thus optimizing O_2 availability for biological oxygen demand (BOD)-induced O_2 reductions
 - carbon dioxide reduction (decarbonation)
 - oxidation of iron and manganese found in many well waters (oxidation tower)
 - ammonia and hydrogen sulfide reduction (stripping)

Aeration is also an effective method of bacteria control.

(From:

http://www.gewater.com/handbook/ext_treatment/ch_4_aeration.jsp)

- Aesthetic enhancement
 - The Homewood Stream restoration project will provide for an improvement in aesthetic value, which is difficult to quantify. However, currently, the stream is highly constrained both physically and visually in two ways. Where the creek is running in its bed up and down gradient of the culvert, as previously mentioned, the creek is constrained. Upslope of the culvert, the creek is overgrown by willows making viewing difficult to impossible. Down gradient of the culvert, the creek is surrounded on both sides by parking lots (see figs 1, 4, and 5) and screened by willows, making viewing uninteresting and difficult. The restoration plan includes open areas on both sides of the creek, a wider creek bank not so constrained by willows and elimination of the culvert which will create a more natural appearing and functioning creek. These improvements are designed with aesthetics in mind and allow unimpeded view corridors and easier access creek viewing areas. Coincidentally, the enhancement of aesthetic value coincides with Lahontan's 'recreational' beneficial use.
- Habitat

- Creek restoration will incorporate habitat improvement from fish passage potential to avian habitat improvement. Fish passage will be enhanced by the stream configuration itself and shading will be more consistent (shading currently consists of some sections of completely shaded creek with other areas completely open). Avian habitat will also be enhanced by the development of more diverse habitat for birds which will include more shrub species both for nesting and for food values in mind. Willow, alder and various current species will be planted as well as grasses and forbs, which will also enhance rodent habitat. Willows will be less dense, allowing more freedom of movement through the stream corridor.
- Sediment
 - Sediment will be addressed through the velocity reduction in the stream itself. This is not likely to be a major influence but will assist in medium to coarse sediment reduction.

Table 1: Lahontan Regional Water Quality Beneficial Uses. Beneficial uses in blue font are directly addressed by this project.

Beneficial Use	Indicator of Unacceptable Disturbance (Water Quality Protection Criteria)
Municipal and Domestic Supply	1. California ambient water quality standards <ul style="list-style-type: none"> a. Total Dissolved Solts 60mg/l b. Chlorine 0.1mg/l c. Nitrogen 0.15mg/l d. Phosphorus 0.018mg/l 2. Suspended sediment concentrations in streams tributary to Lake Tahoe shall not exceed a 90th percentile value of 60 mg/L.
	3. Waters shall not contain concentrations of coliform organisms attributable to anthropogenic sources, including human and livestock wastes.
Ground Water Recharge	In ground waters designated as MUN, the median concentration of coliform organisms over any seven-day period shall be less than 1.1/100 milliliters.
Water Contact Recreation	Waters shall not contain concentrations of coliform organisms attributable to anthropogenic sources, including human and livestock wastes.
Noncontact Water Recreation	None
Commercial and Sportfishing	High heavy metal concentrations
Cold Freshwater Habitat	Same as Spawning, Reproduction, and Development
Wildlife Habitat	None defined
Spawning, Reproduction, and Development	Species dependent standards, however lake clarity sediment protection standard would protect all fish and invertebrate species.
Suspended Sediment Objective for Lake Tahoe	Suspended sediment concentrations in streams tributary to Lake Tahoe shall not exceed a 90 th percentile value of 60mg/L. (Lahontan Basin Plan, 1995)

SUMMARY

The Homewood Creek restoration project is designed to provide ecological and aesthetic benefits to a 300+ foot section of creek in the Homewood South Base area that has been channelized and constrained. The conceptual plans describe a creek restoration project that enhances ecological function through widening, adding step pools, developing flood plains and increasing plant and habitat diversity. These functions also address many of the Lahontan 'Beneficial Uses' and supports TRPA's Soil Conservation SC-2 Stream Environment Zone indicator. Given the current constrained nature of the stream and adjacent SEZ, initial calculations suggest that we will expand SEZ area by at least 100%. The

Homewood Creek Restoration Project is also designed to provide a much higher level of human interaction with and aesthetic improvement of the creek by providing walking and viewing areas adjacent to the creek.



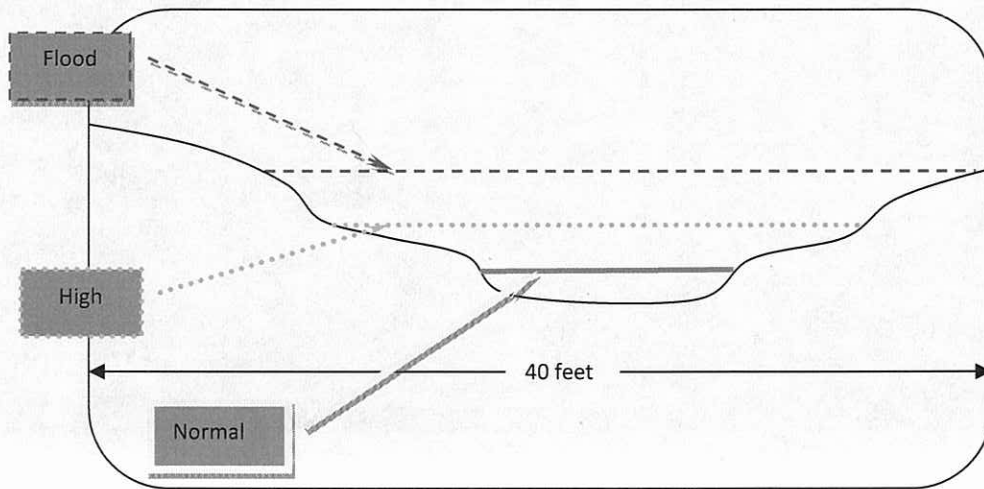
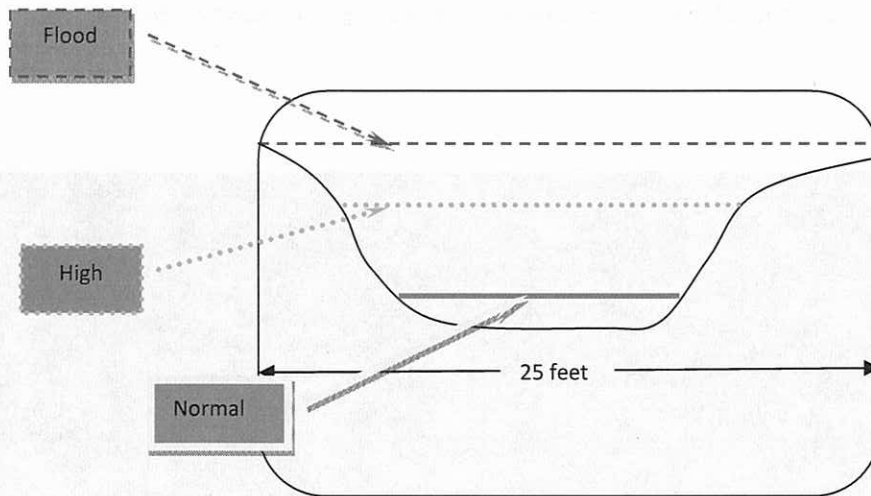
Figure 3: Location of South Base stream restoration area



Figure 4: Google Earth image showing location of stream restoration. Approximate length of restoration: 340 feet



Figure 5: Oblique Google Earth image showing approximate alignment of stream restoration and approximate new road alignment



Figures 6 and 7 showing typical cross sections of before (fig 6) and after (fig 7) restoration. Prior to restoration, a give volume of water is constrained. That same volume, after restoration has more area to fill, thus reducing flows and energy at a given point. This figure compares conceptual normal, spring high and flood or extreme flows, indicating that extreme flows are more likely to exceed bank full height prior to restoration.

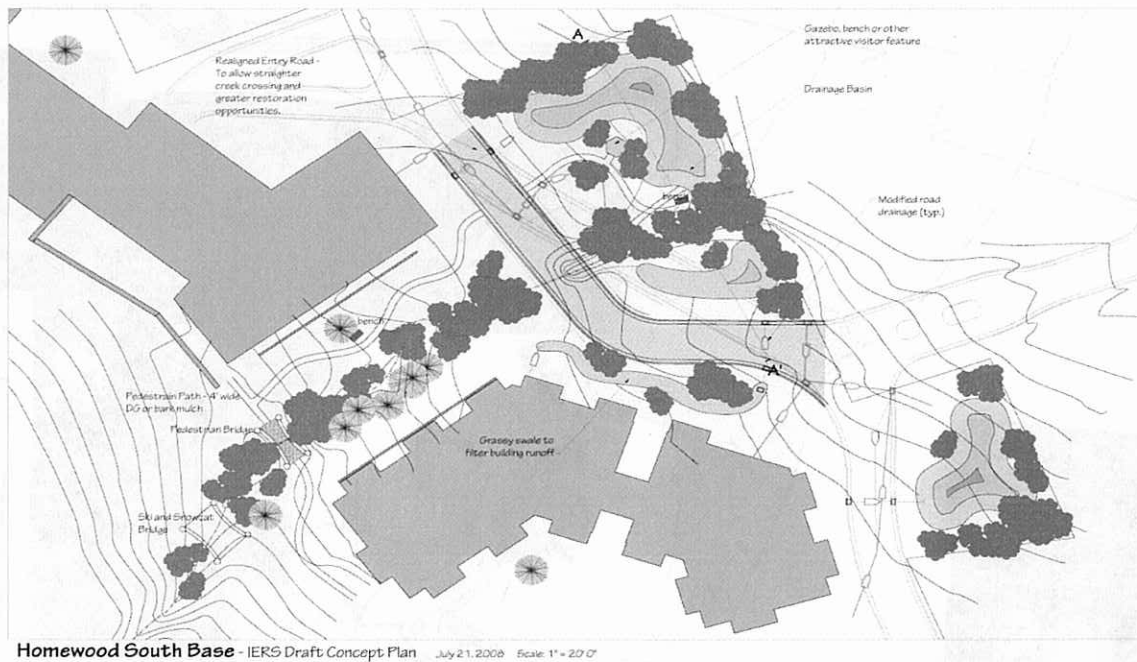


Figure 9: architect's concept plan of stream restoration showing viewing areas